(ICASEMCT-2023)

INTERNATIONAL CONFERENCE

on

"Advancements in Smart Electronics, Materials and Communication Technologies"

(ICASEMCT-2023)

FEBRUARY 17-18, 2023

CONFERENCE PROCEEDINGS

ISBN No.: 978-81- 954233-1-6

Organized by

Department of Electronics and Communication Engineering

Swami Keshvanand Institute of Technology, Management & Gramothan, Jaipur

icasemct.skit.ac.in

Table of Contents

Quantum Dots: A review

Kiran Rathi
Department of Electronics and Communication Engineering, Swami Keshvanand Institute of Technology, Management & Gramothan, Jaipur, Rajasthan, 302017
kiran.rathi@skit.ac.in

Chandra Mohan Singh Negi
Department of Physical Sciences, Banasthali Vidyapith, Banasthali, Newai, Rajasthan, 304022, India

Vikas Pathak
Department of Electronics and Communication Engineering, Swami Keshvanand Institute of Technology, Management & Gramothan, Jaipur, Rajasthan, 302017

***Abstract*—Studies on nanotechnology and nanoscience have gained increased attention over the past ten years. The creation of quantum dots is one of the significant advancements in this area (QDs). Herein the important aspects of QDs are highlighted such as quantum confinement, properties and basic elements of QDs, structure of QDs and their potential applications. Quantum dots (QDs) are nanoparticles or formations that demonstrate three-dimensional quantum confinement, which gives rise to numerous distinctive optical and transport features. The unique optical and electrical properties of the quantum dots make them favorable for multitasking purposes. Several researches have shown the wide variety of quantum dot applications in photovoltaic and laser devices, thin-film transistors, light-emitting diodes, and luminescent labels in biology and medicine.**

Keywords — Quantum dots, nanoparticles, quantum confinement, bandgap.

I. Introduction

Colloidal fluorescent semiconductor nanoscale crystals known as quantum dots were initially created in the early 1980s[1]. These dot systems have proven to be effective for examining a variety of physical processes. The term "quantum dots" (QDs) is frequently used to refer to extremely small artificial semiconductor particles, typically less than 10 nm. Optical and electrical properties of QDs are distinct from the bulk material's properties because of their remarkably small size.

Most QDs can be stimulated by light or electricity to produce light of a certain wavelength. Because QDs' form and size dictate their electrical properties, the size of QDs can be varied to alter their emission wavelengths. Typically, QDs with smaller sizes (such those with a radius of 2–3 nm) emit light at shorter wavelengths, producing hues like violet, blue, or green. In contrast, larger QDs (with 5–6 nm radius, for example) produce longer wavelengths, which result in colours like red, orange, or yellow. QDs interesting, extremely adjustable optical features dependent on QDs size have given rise to a wide range of academic and industrial uses, such as bio imaging, solar cells, LEDs, diode lasers, and transistors.

These days, quantum dots of various types are created by first creating nanocrystals using atoms from the periodic table's groups II-VI, III-V, or IV-VI (Table-1). Additionally, the systems GaAs-ZnS, GaAs-ZnTe, InP-ZnS, InP-ZnSe, and InP-CdS can be combined to produce quantum dots. These synthetic semiconductor nanoparticles frequently have distinctive optical, electronic, and photophysical characteristics that make them desirable for promising uses in fluorescent biological labelling, imaging, solar cells, composites, and detection as well as effective donors of fluorescence resonance energy.

Table 1: An overview of the various quantum dot types [2-4]

Type	Quantum dots
IB-VI	Ag_2S, ZnAgS, CuS, $CuInS_2$, $CuInSe_2$
IIB- VI	CdS, CdSe, CdTe, ZnS, ZnSe, ZnTe, HgS, HgSe, HgTe
IIIA- V	GaAs, InGaAs, InP, InAs, InGaN
IV- VI	PbSe, PbS
IV	C, Si, Ge

The optical properties of the particle can finely change with size depending on the relationship between the energy and wavelength of light (or colour). Therefore, distinct coloured particles that emit or absorb particular wavelengths of light can only be created by manipulating the size of quantum dots. Quantum confinement causes various-sized quantum dots to emit light of various colours, as seen in Fig. 1.

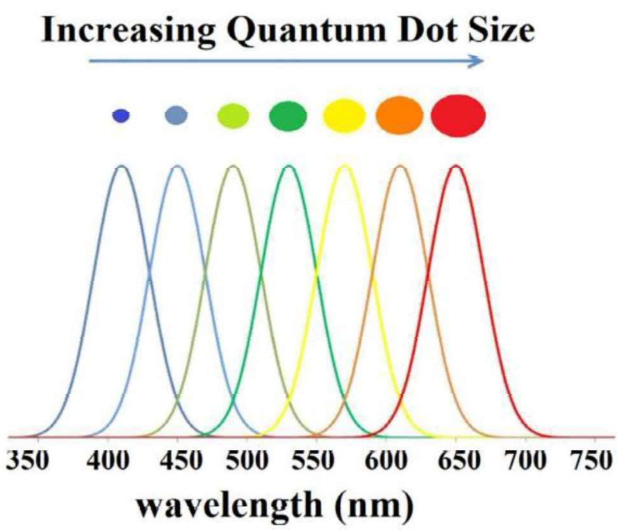

Fig. 1. Quantum dot fluorescence spectra of various sizes [5]

ISBN No. 978-81-954233-1-6